**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

| | | | |
|---|---|---|---|
| Appl. No. | : | 09/885,319 | Confirmation No.: 4594 |
| Applicant | : | Mark A. Stan, *et al.* | |
| Filed | : | June 19, 2001 | |
| TC/A.U. | : | 1753 | |
| Examiner | : | Diamond, Alan D. | |
| Docket No. | : | 1003 (previously 1613370-0006) | |
| Customer No. | : | 007470 | |

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**DECLARATION UNDER 37 C.F.R. § 1.131**

I, the undersigned, declare that:

1. My name and residence is as listed below.

2. I am a joint inventor in the above-identified patent application ("The Patent Application").

3. The undersigned Hong Q. Hou participated in the development of processes for the fabrication of solar cells, and prepared records describing such processes, prior to March 29, 1999.

4. The document attached hereto as Exhibit 1 is a summary of an actual process control instruction sheet as stored in computer archival storage maintained by the assignee of the Patent Application, Emcore Corporation of Somerset, New Jersey ("Emcore"), at its

Albuquerque, New Mexico facility. The print-out was printed from the archival storage file on May 4, 2004, as indicated by the date on the top right hand portion of page 1.

5. Associated file records of Emcore, attached hereto as Exhibit 2, with the actual dates being redacted, show that the date of the original document represented in Exhibit 1, and correspondingly the actual E6523 process run itself, was made prior to March 29, 1999.

6. Exhibit 1 is a summary of the growth "recipe" of a test run of a triple-junction solar cell. The "recipe" is a sequence of instructions for controlling an Emcore E400 Reactor (hereinafter, the "Reactor") installed at Emcore's facilities in Somerset, New Jersey, used for metal organic chemical vapor deposition (MOVCD) growth of identified chemical elements or compounds on the surface of a substrate contained in the reactor chamber.

7. Each line in the summary file represents a distinct layer of the solar cell or a process step performed as part of the fabrication process.

8. The detailed recipe control from which this summary was generated was loaded into a control computer of an E-400 model MOVCD reactor to control the "on" or "off" switches and amount of gas flow of each chemical from a bubbler through gas lines in the reactor.

9. The identified E6523 process identified in Exhibit 1 is one of a number of actual process runs conducted on a germanium substrate for research and development purposes relating to the deposition of surface layers for the creation of different solar cell semiconductor structures that were conducted on the Reactor in Somerset, NJ during 1999.

10. The undersigned Hong Q. Hou participated in both the conception and specification of the materials systems and layers of the desired solar cell, and the actual implementation and performance of the E6523 process of Exhibit 1 on the Reactor. The E6523 process of Exhibit 1 resulted in the fabrication of a wafer including a solar cell having at least an InGaP layer formed directly on the surface of a germanium substrate, *i.e.*, a layer containing both In and P.

11. Referring to page 1 of Exhibit 1, the entry beginning with "TMAl" represents the process instructions for a first reactant, which in the E6523 process actually corresponds to the flow of trimethylindium. The use of the term "Al" in the "TMAl"was included in the software control instructionbecause the software identifying the register of the control line was designed and used in the past for a similar process involving aluminum, rather than indium. Since the use of indium as a constituent element was a new idea, the actual chemical compound in the bubbler connected to the "Al" line was changed to trimethylindium. However, the computer software had not yet been rewritten to designate "indium" or "In" instead of "aluminum" or "Al," along with its deposition conditions when the actual E6523 process was performed.

12. The process associated with the flow of trimethylindium at various timed intervals is represented by the sequence of columns to the right of the process instruction entries labeled Layer #1, Layer #2, etc., with various specified time durations.

13. The process instructions on page 1, line 4 beginning with "TMGa# 1-4," and continuing on to the first two entries on page 2, correspond to the flow of trimethylgallium, the metal organics for gallium.

14. On page 2, line 3 of Exhibit 1, the process instructions labeled "ASH3#2_42" on page 2, line 3, corresponds to the flow of arsine.

15. On page 2, line 4, the entry line labeled "PH3_43" identifies a process instruction to the Reactor associated with the flow of phosphine at various timed intervals represented by the columns (labeled on page 1) as Layer #1 (4.000 min), Layer #2 (6.000 min), etc. The letters "V" and "R" indicate that the flow is switched from a "vent" position to a "run" position, with the phosphine being introduced into the reactive chamber at the time intervals corresponding to the "R" notations.

16. The nucleation layer is designed to be n-type doped in InGaP on Ge. During the growth of the nucleation layer of InGaP, only TMIn and TMG were supplied for group-III growth; phosphine for group-V growth, and a doping quantity of silane was provided as dopant.

17. The ratio of gas flows between TMIn and TMGa were adjusted to make the lattice constant of InGaP match that of the Ge substrate.

18. Although it is not designated in Exhibit 1, a germanium substrate was selected and used in the E6523 process.

19. The undersigned Mark A. Stan, Nein Y. Li, Frank A. Spadafora, Paul R. Sharps, and Navid S. Fatemi each participated in the development of the subject matter claimed in this patent application after March 29, 1999.

20. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statement were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

Name: Mark A. Stan

City: Albuquerque, NM

Signature: [signature] Date: 3-29-2006

Name: Nein Y. Li

City: Albuquerque, NM

Signature: [signature] Date: 3-29-06

Name: Frank A. Spadafora

City: BADEN, PA

Signature: [signature] Date: 3-22-2006

Name: Hong Q. Hou

City: _____

Signature: _____ Date: _____

Name: Paul R. Sharps

City: Albuquerque, NM

Signature: Paul R. Sharps Date: 3/29/06

Name: Navid S. Fatemi

City: Albuquerque, NM

Signature: [signature] Date: 3/29/06

Name: Mark A. Stan

City: Albuquerque, NM

Signature: Mark A. Stan Date: 3/24/06

Name: Nein Y. Li

City: _____

Signature: _____ Date: _____

Name: Frank A. Spadafora

City: _____

Signature: _____ Date: _____

Name: Hong Q. Hou

City: Arcadia, CA

Signature: _____ Date: 04/10/06

Name: Paul R. Sharps

City: _____

Signature: _____ Date: _____

Name: Navid S. Fatemi

City: _____

Signature: _____ Date: _____

# EXHIBIT 1

E6523 Process

5/4/2004
11:47 AM
Page 1

Emcore Process Printout

This process is stored in the file :
Directory : \\mat\sys\User\ech6\runs
Filename : E6523TJN.ERF

Total Run Time : 94.501 min

This printout contains the following fields :
Process Control Line Set Point
Process Control Line Command

Process comments :

NUC66 recipe: P drive-in instead of As drive-in
2P, 3P mixed platter with new pockets
BASELINE: e6517 WITH MODIFICATIONS AND SPECIFICS
Modifications: Baseline for TJN runs
Layer30, Time 1.9>0.95 min (InGaAlP BSF), InGaP base 10>6.5 min
Purpose: P drive-in with InGaP nucleation

Test: Surfscan, Polaron, PL, and V-probe

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Page 2

Emcore Process Printout

| | Layer # 1 | Layer # 2 | Layer # 3 | Layer # 4 | Layer # 5 |
|---|---|---|---|---|---|
| | 4.000min | 6.000min | 6.000min | 2.000min | 2.000min |
| TMAl_7 | 400.00ccm I | 400.00ccm I | 400.00ccm V | 650.00ccm V | 852.00ccm V |
| TMAl#1 Pres_23 | 250.0Tor R | 250.0Tor R | 250.0Tor R | 250.0Tor R | 250.0Tor R |
| TMAl#1_7 MoleFr | 0.5700per I | 0.5700per I | 0.5700per I | 0.5700per I | 0.5700per I |
| TMGa#1_4 | 41.00ccm I | 41.00ccm I | 41.00ccm I | 41.00ccm I | 41.00ccm V |
| TMGa#1 Pres_20 | 950.0Tor R | 950.0Tor R | 950.0Tor R | 950.0Tor R | 950.0Tor R |
| TMGa#2_5 | 140.00ccm I | 140.00ccm I | 140.00ccm I | 140.00ccm I | 140.00ccm I |
| TMGa#2 Pres_21 | 350.0Tor | 350.0Tor | 350.0Tor | 350.0Tor | 350.0Tor |

E6523 Process

| | | | | | |
|---|---|---|---|---|---|
| | R | R | R | R | R |
| TEGa_6 | 36.10ccm | 36.10ccm | 36.10ccm | 36.10ccm | 36.10ccm |
| | I | I | I | I | I |
| TEGa Pres_22 | 475.0Tor | 475.0Tor | 475.0Tor | 475.0Tor | 475.0Tor |
| | R | R | R | R | R |
| ASH3#2_42 | 0.0ccm | 0.0ccm | 0.0ccm | 0.0ccm | 0.0ccm |
| | V | V | V | V | V |
| PH3_43 | 0ccm | 400ccm | 400ccm | 400ccm | 1800ccm |
| | V | R | R | R | R |
| CCl4_1 | 200.00ccm | 200.00ccm | 200.00ccm | 200.00ccm | 200.00ccm |
| | I | I | I | I | I |
| CCl4 Dil_57 | 200.0ccm | 200.0ccm | 200.0ccm | 200.0ccm | 200.0ccm |
| | R | R | R | R | R |
| CCl4 mix_58 | 133.00ccm | 133.00ccm | 133.00ccm | 133.00ccm | 133.00ccm |
| | R | R | R | R | R |
| CCl4 Pres_17 | 300.0Tor | 300.0Tor | 300.0Tor | 300.0Tor | 300.0Tor |
| | R | R | R | R | R |

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Emcore Process Printout

| | Layer # 6 | Layer # 7 | Layer # 8 | Layer # 9 | Layer # 10 |
|---|---|---|---|---|---|
| | 0.200min | 0.650min | 3.000min | 0.200min | 12.000min |
| TMAl_7 | 852.00ccm | 852.00ccm | 400.00ccm | 400.00ccm | 400.00ccm |
| | V | | I | I | I |
| TMAl#1 Pres_23 | 250.0Tor | 250.0Tor | 250.0Tor | 250.0Tor | 250.0Tor |
| | R | R | R | R | R |
| TMAl#1_7 MoleFr | 0.5700per | 0.5700per | 0.6000per | 0.6000per | 0.6000per |
| | R | R | I | I | I |
| TMGa#1_4 | 41.00ccm | 41.00ccm | 100.00ccm | 100.00ccm | 100.00ccm |
| | V | R | V | V | R |
| TMGa#1 Pres_20 | 950.0Tor | 950.0Tor | 950.0Tor | 950.0Tor | 950.0Tor |
| | R | R | R | R | R |
| TMGa#2_5 | 140.00ccm | 140.00ccm | 140.00ccm | 140.00ccm | 140.00ccm |
| | I | I | V | V | R |
| TMGa#2 Pres_21 | 350.0Tor | 350.0Tor | 350.0Tor | 350.0Tor | 350.0Tor |
| | R | R | R | R | R |
| TEGa_6 | 36.10ccm | 36.10ccm | 36.10ccm | 36.10ccm | 36.10ccm |
| | I | I | I | I | I |

E6523 Process

| | | | | | |
|---|---|---|---|---|---|
| TEGa Pres_22 | 475.0Tor R | 475.0Tor R | 475.0Tor R | 475.0Tor R | 475.0Tor R |
| ASH3#2_42 | 0.0ccm V | 0.0ccm V | 0.0ccm V | 1200.0ccm V | 1200.0ccm R |
| PH3_43 | 2000ccm R | 2000ccm R | 400ccm R | 400ccm R | 0ccm V |
| CCl4_1 | 200.00ccm I | 200.00ccm I | 200.00ccm I | 200.00ccm I | 200.00ccm I |
| CCl4 Dil_57 | 200.0ccm R | 200.0ccm R | 200.0ccm R | 200.0ccm R | 200.0ccm R |
| CCl4 mix_58 | 133.00ccm R | 133.00ccm R | 133.00ccm R | 133.00ccm R | 133.00ccm R |
| CCl4 Pres_17 | 300.0Tor R | 300.0Tor R | 300.0Tor R | 300.0Tor R | 300.0Tor R |

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Page 4

Emcore Process Printout

| | Layer # 11 2.400min | Layer # 12 0.100min | Layer # 13 1.330min | Layer # 14 0.500min | Layer # 15 1.000min |
|---|---|---|---|---|---|
| TMAl_7 | 400.00ccm I | 400.00ccm I | 400.00ccm I | 400.00ccm I | 400.00ccm I |
| TMAl#1 Pres_23 | 250.0Tor R | 250.0Tor R | 250.0Tor R | 250.0Tor R | 250.0Tor R |
| TMAl#1_7 MoleFr | 0.6000per I | 0.6000per I | 0.6000per I | 0.6000per I | 0.6000per I |
| TMGa#1_4 | 100.00ccm R | 54.17ccm V | 54.17ccm R | 54.17ccm V | 54.17ccm R |
| TMGa#1 Pres_20 | 950.0Tor R | 950.0Tor R | 950.0Tor R | 950.0Tor R | 950.0Tor R |
| TMGa#2_5 | 140.00ccm R | 140.00ccm I | 140.00ccm I | 140.00ccm I | 140.00ccm V |
| TMGa#2 Pres_21 | 350.0Tor R | 350.0Tor R | 350.0Tor R | 350.0Tor R | 350.0Tor R |
| TEGa_6 | 36.10ccm I | 36.10ccm V | 36.10ccm V | 36.10ccm V | 36.10ccm R |
| TEGa Pres_22 | 475.0Tor R | 475.0Tor R | 475.0Tor R | 475.0Tor R | 475.0Tor R |
| ASH3#2_42 | 1200.0ccm R | 400.0ccm R | 400.0ccm R | 400.0ccm R | 400.0ccm R |

Page 3

E6523 Process

| | | | | | |
|---|---|---|---|---|---|
| PH3_43 | 0ccm V | 0ccm V | 0ccm V | 0ccm V | 0ccm V |
| CCl4_1 | 200.00ccm V | 200.00ccm V | 200.00ccm V | 200.00ccm V | 200.00ccm R |
| CCl4 Dil_57 | 200.0ccm R | 200.0ccm R | 200.0ccm R | 200.0ccm R | 200.0ccm R |
| CCl4 mix_58 | 133.00ccm R | 133.00ccm R | 133.00ccm R | 133.00ccm R | 133.00ccm R |
| CCl4 Pres_17 | 300.0Tor R | 300.0Tor R | 300.0Tor R | 300.0Tor R | 300.0Tor R |



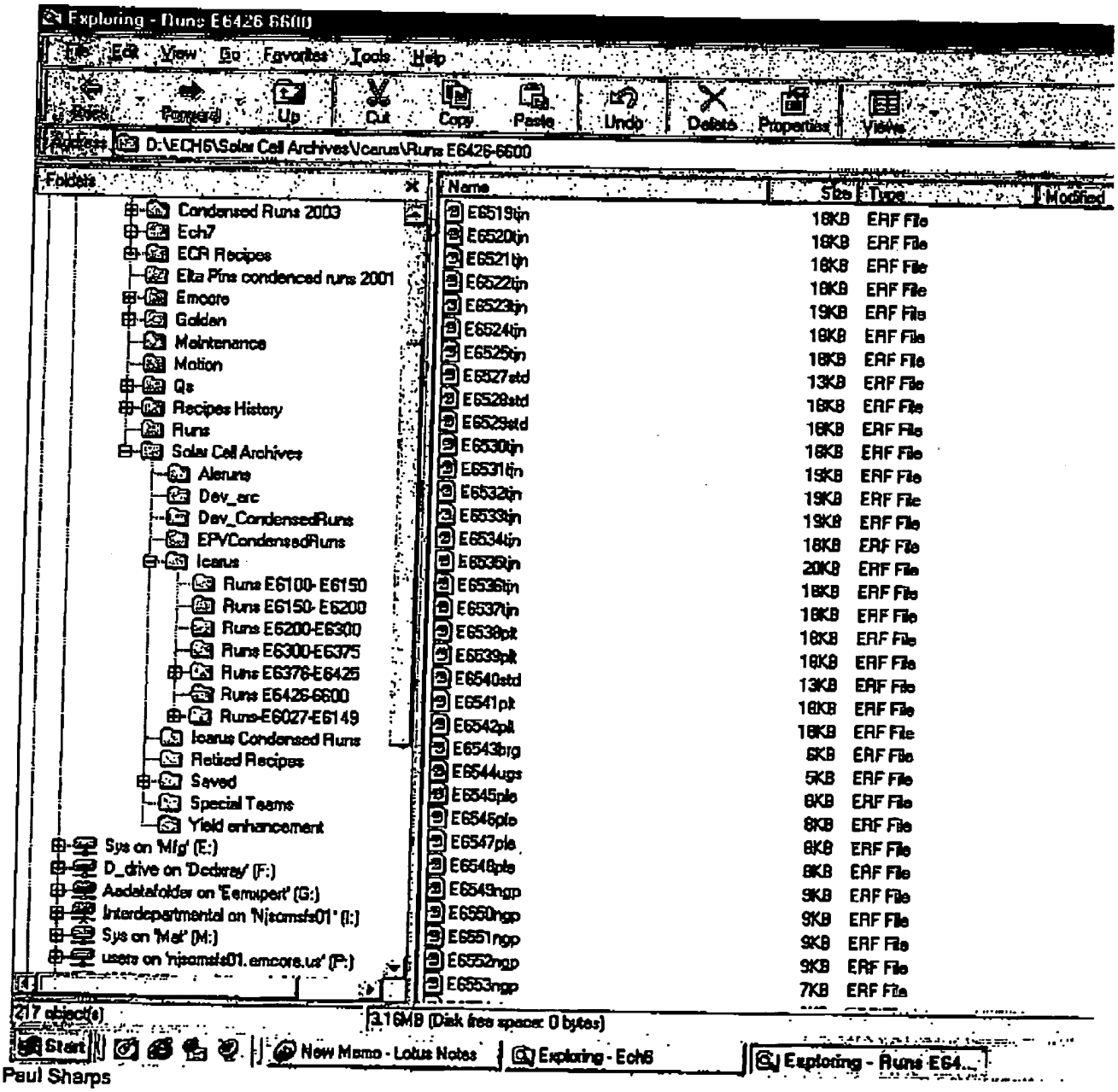
Emcore Process Printout

| | Layer # 16 1.000min | Layer # 17 0.100min | Layer # 18 9.000min | Layer # 19 3.000min | Layer # 20 2.000min |
|---|---|---|---|---|---|
| TMAl_7 | 400.00ccm I | 400.00ccm I | 400.00ccm I | 400.00ccm V | 650.00ccm V |
| TMAl#1 Pres_23 | 250.0Tor R | 250.0Tor R | 250.0Tor R | 250.0Tor R | 250.0Tor R |
| TMAl#1_7 MoleFr | 0.6000per I | 0.6000per I | 0.6000per I | 0.6000per I | 0.6000per I |
| TMGa#1_4 | 54.17ccm R | 100.00ccm V | 100.00ccm R | 100.00ccm R | 100.00ccm R |
| TMGa#1 Pres_20 | 950.0Tor R | 950.0Tor R | 950.0Tor R | 950.0Tor R | 950.0Tor R |
| TMGa#2_5 | 140.00ccm V | 140.00ccm V | 140.00ccm R | 140.00ccm R | 140.00ccm R |
| TMGa#2 Pres_21 | 350.0Tor R | 350.0Tor R | 350.0Tor R | 350.0Tor R | 350.0Tor R |
| TEGa_6 | 36.10ccm R | 36.10ccm I | 36.10ccm I | 36.10ccm I | 103.00ccm I |
| TEGa Pres_22 | 475.0Tor R | 475.0Tor R | 475.0Tor R | 475.0Tor R | 475.0Tor R |
| AsH3#2_42 | 1000.0ccm R | 1200.0ccm R | 1200.0ccm R | 1200.0ccm R | 1200.0ccm R |
| PH3_43 | 0ccm V | 0ccm V | 0ccm V | 0ccm V | 0ccm V |
| CCl4_1 | 50.00ccm | 200.00ccm | 200.00ccm | 200.00ccm | 200.00ccm |

BEST AVAILABLE COPY

Joe Conklin /Emcore
05/05/2004 07:08 AM

To Paul Sharps/Emcore@Emcore
cc Rick Stall/Emcore@Emcore
bcc
Subject Re: Fw: GaInP2 Nucleation




Paul Sharps